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VIGOUR ASSESSMENT IN *Pinus radiata* D. DON SEEDS

A thesis presented in partial
fulfilment of the requirements for the degree of
Master of Agricultural Science in Seed Technology
at Massey University, Palmerston North,
New Zealand

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1990

ABSTRACT

Kartiko, H.D.P.: M.Agr.Sc. (Seed Technology)

Title of Thesis: Vigour Assessment in *Pinus radiata* D. Don Seeds

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The sensitivity and/or predictivity of various vigour test methods (which include conductivity, tetrazolium, x-ray contrast, seedling growth, controlled deterioration, complex stressing vigour, and low temperature/osmotic stress tests) for prepared lots of Pinus radiata seeds were investigated in this study. The best tests were the controlled deterioration test with two days aging treatment (CD2d test), the prechilled seedling growth test (SG+pr test), and the complex stressing vigour test (CSV test). These were then further investigated to evaluate their ability to predict the performance of different seed lots at the Forest Research Institute (FRI) nursery, Rotorua.

The CD2d, SG+pr and CSV tests showed good correlation, especially with percentage of plantable seedlings at the FRI nursery. In addition, these tests seem to have met most of the AOSA's (1983) criteria for a practical vigour testing, as they are simple and can be done in a relatively short period of time. For application purposes, it is suggested that the test parameters which gave the highest correlation coefficient value with percentage of plantable seedlings in the nursery should be used as a reliable measurement. Therefore,

percentage normal seedlings should be used in either the CD2d or the CSV test, whereas T₅₀ radicle emergence seems more predictive in the SG+pr test.

For application in other nurseries, these tests may still be valid, especially if pre-sowing treatment and nursery conditions are about the same as in the FRI nursery. If conditions do differ, however, the CD2d and SG+pr tests are more likely to be useful than the CSV test. This hypothesis is based on the fact that the CD2d and SG+pr tests also gave good correlations with the glasshouse (optimum conditions) and winter field tests (sub-optimum conditions). In contrast, there was no significant correlation given by the CSV test in relation to the glasshouse and winter field tests.

Seed weight had a significant effect on seedling dry weight and T₅₀ radicle emergence if there was a large seed weight variation between seed lots. In this case, generally heavier seeds had better performance than the lighter ones. If there was only small variation in overall seed weight among seed lots, however, the important effects of individual differences in seed weights were masked.

The direction of further studies would seem to be to evaluate the reproducibility of correlation coefficient values and regression equations by the CD2d, SG+pr and CSV tests in the same nursery site over several sowings. Additionally, vigour test evaluation using seed lots from individual clones would also seem to be important.

ACKNOWLEDGEMENTS

In the name of Allah most gracious, most merciful. Praise be to Almighty Allah, the Lord of Universe, and may peace be upon prophet Muhammad s.a.w. and his family.

I wish to express my appreciation and sincere gratitude to my parents, my parents-in-law, my wife, my son, and my brothers and sisters for all their support and sacrifices.

Then I also extend my thanks and gratitude to Dr P. Coolbear for his constructive suggestions and supervision in the conduct of this study, and to Dr M.J. Hill, Mr C.R. McGill and all of the staff of the Seed Technology Centre for all their help and support. I also gratefully acknowledge the help and support of Mr A. Firth, Dr M.I. Menzies, and Mr Mike Dibley of the New Zealand Forest Research Institute, Rotorua.

I also extend my thanks to the Indonesian and New Zealand Governments which have contributed greatly in various phases of this study, and also to the Director and staff of the Forestry Seed Technology Centre, Bogor, Indonesia for all their help and support.

Finally, I also express my gratitude to all of my friends and other people not already mentioned for all of their cooperation and good relationships.

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I. INTRODUCTION

Pinus radiata which originally might have come from Ano Nuevo Point, on the southwestern part of the North American coast (Bannister, 1973) nowadays covers over one million hectares of plantation forests in New Zealand (FRI, 1987) and produces a very useful and versatile wood, e.g. logs, solid timber, wood chips, pulp and paper. These account for ten percent of New Zealand's overseas earnings (Clifton, 1985). It has a medium density soft wood with an even texture. In addition, the physical structure of the wood permits ready preservative treatment. Therefore, the end products are stable, strong, resistant to insects and fungi, and easily finished with a variety of stains, clear finishes, paint and overlays (FRI, 1987).

For planting purposes, a large number of genetically improved seed is needed, and for 1984-1985 season, for example, the seed demand was about 3500 kg. To fulfil this demand, almost all of the current seed production is from 850 series clones and half of the total quantity is collected from Gwavas orchard. By 1990, production from 850 series clones is planned to be reduced and almost completely replaced by seed from 268 and 875 series clones collected mainly from Kaingaroa orchard (Vincent, 1986). Despite the fact that these seeds are genetically improved, the vigour of the seeds at present seems to be quite low, even though laboratory germination tests show that at least 90% of seeds are viable (see section 2.1.2.). Therefore, it is important to select the best seed production methods, and the best clones which can produce high vigorous seeds. This requires the identification of suitable vigour tests for this species.

It appears that there are not many reports concerning vigour tests in *P. radiata* or other tree species. In the few studies which have been conducted there has been little attempt to

correlate results with field performance. This analysis is very crucial, as high vigour seeds according to a vigour test do not always produce good performance in the field (see section 2.3.).

In some agricultural seeds, some vigour tests gave high and significant correlation with field performance in certain stations. However, they may give poor correlations with field performance in other stations (see section 2.3.). Therefore, an investigation to look for a general vigour test with suitability for all kind of field conditions seems to be over ambitious (see Hampton and Coolbear, 1990).

Based on these reasons, vigour test evaluation in *P. radiata* was conducted in this study with objectives as follows:

- (i) to characterise the seed deterioration pattern in *P. radiata*, in order to determine suitable aging treatments for creating seed lots which have different vigour levels,
- (ii) to investigate promising suitable vigour tests for *P. radiata*, and
- (iii) to investigate these tests for their suitability for predicting seedling establishment in the nursery at the Forest Research Institute (FRI), Rotorua.

To fulfil these objectives, three stages of experimentation were conducted in this study. The first stage was a study using accelerated aging techniques to determine the best methods of preparing deteriorated seed lots. The second stage was evaluation of various vigour test methods using 5 prepared seed lots which varied according to seed weight and age. The third stage was evaluation of the best test methods (i.e. the controlled deterioration test with 2 days aging treatment, the prechilled seedling growth test, and the

complex stressing vigour test) to predict seedling performance at the FRI nursery using 16 mixed seed lots which varied according to type of mother tree and collection date.